the *Leptochiton ruber*, (p. 399, Plate XXV, fig. 166.) This adheres to rocks and stones that are incrusted by the red nullipore *Lithothamnion polymorphum*, with which its red color, of various shades, agrees very closely. It is a far more abundant shell in the Bay of Fundy, where it also lives among the same nullipore. Among the other less common northern species, met with on these bottoms, are *Rissoa exarata*; *Lacuna neritoidea*; and *Astyris rosacea*.

Several very interesting species of naked mollusks (*Nudibranchs*) occur on these bottoms, creeping over algæ and hydroids, and feeding upon the latter. One of the most conspicuous of these is the *Dendronotus arborescens*, which is a northern form, and had not been found south of Cape Cod until this spring, when we dredged it on the reef off Watch Hill, in four or five fathoms. It can be easily distinguished by the two rows of large arborescently-branched gills along the back; by the branched lobes of the tentacle-sheaths and the arborescently divided branch on their outer side, near the base; and by the very narrow and almost linear foot, which is adapted for creeping over hydroids.

The *Onchydoris pallida* was dredged by Messrs. Prudden and Russell, off Cuttyhunk Island, in April, 1872. It has not been previously recorded from south of Cape Cod, but it is common in the Bay of Fundy. It can easily be recognized by its pale yellow color, and the long, blunt-conical papillæ that cover its back.

The *Æolis papillosa* and *Tergipes despectus* were both found at Watch Hill this spring, April 13, and are new additions to the fauna of southern New England. The former was found, with its eggs, among the roots of *Laminaria*; the latter was abundant in four or five fathoms, creeping over *Obelia geniculata*, which was abundant on the fronds of *Laminaria*. Its eggs, inclosed in small masses of gelatinous matter were attached to the *Obelia* in large numbers. The *Doto coronata*, (Plate XXV, fig. 170,) was associated with the *Tergipes* on the *Obelia*. An undetermined species of *Æolis*, with bright red branchiæ, was dredged off Gay Head, on a rocky bottom.

The Lamellibranchs are not of much interest, and scarcely any are peculiar to this kind of bottom. The *Modiola modiolus* (p. 309, Plate XXXI, fig. 237) is one of the most common and characteristic species. The northern scaly or spiny *Anomia aculeata* (Plate XXXII, figs. 239, 240) is common; it adheres to rocks, shells, and the roots and stems of large algæ.

Among the Ascidians there are several northern species, not before found so far south. The *Cynthia carnea* (Plate XXXIII, figs. 247, 248) was found off Gay Head in ten fathoms. The young specimens were numerous on the stones and shells. In contraction they are low and flat, with a thin margin; the color is light red, or flesh-color. With this a few young specimens of *Cynthia echinata* were found. These are peculiar in being covered by stellate spines. The color of the young specimens is pink, the apertures rose-red. The *Molgula papillosa* also occurred spar-

ingly with the last two species. This is also a northern species, common in the Bay of Fundy. Among the compound Ascidians the only species found here that did not occur also in Vineyard Sound was *Amarœcium pallidum*, a small species, which forms small rounded or turbinated whitish masses, of a firm gelatinous appearance, but with fine grains of sand imbedded in the substance. It is a common species in the Bay of Fundy.

The Bryozoa are represented by numerous species, some of which are very abundant. The *Membranipora pilosa* (Plate XXXIV, figs. 262, 263) is one of the most abundant. It incrusts, and often entirely covers, the fronds of various algæ, especially of *Phyllophora Brodiœi*, *P. membranifolia*, *Rhodymenia palmata*, *Delesseria sinuosa*, &c. On the reef off Watch Hill it was particularly abundant on these and other algæ, shells, &c. It is easily distinguished by the single long spine at the proximal end of the cell, and by the shorter ones along the sides. With the preceding, *Crisia eburnea*, (p. 311, Plate XXXIV, figs. 260, 261;) *Tubulipora flabellaris*; *Cellepora ramulosa*, (p. 312;) and a species of *Discopora*, allied to *D. coccinea*, were very abundant, adhering to the more slender red algæ. A species of *Lepralia*, of a reddish color, and forming both incrusting and lichen-like corals, was common. In this the apertures of the cells are large, operculated, broadest proximally, and each one has a short, stout, conical spine at its proximal border, which is scarcely visible except in a profile view.

The *Bugula Murrayana*, which forms clusters of broad, thin, flexible fronds nearly two inches high, was dredged several times. It is very common in the Bay of Fundy. An incrusting species of *Alcyonidium*, perhaps identical with *A. gelatinosum* of Europe, occurred on the red algæ. A species of *Cellularia*, allied to *A. ternata*, was also obtained.

The Echinoderms are represented by the common green sea-urchin, *Strongylocentrotus Dröbachiensis*, (p. 406, Plate XXXV, fig. 268,) which is common off Gay Head, and as far as off New London, though far less abundant than in the Bay of Fundy; by the common red or purple star-fish, *Asterias vulgaris*, (p. 407,) which was abundant off Gay Head and on the reef off Watch Hill; *Cribrella sanguinolenta*, (p. 407,) which is not uncommon as far west as the Watch Hill reef, and off New London; and by the *Ophiopholis aculeata*, (Plate XXXV, fig. 270,)which was only once met with off Gay Head, but of which we dredged several specimens on the reef off Watch Hill. The last-named species is extremely abundant in the Bay of Fundy and northward, from low-water to the depth of more than one hundred fathoms.

The Hydroids are very numerous on the rocky and stony bottoms, attached to algæ, stones, shells, ascidians, &c. One of the most abundant is *Obelia geniculata*, (p. 407,) which grows on the fronds of *Laminaria*, *Rhodymenia*, and other algæ; it often nearly covers one or both sides of the broad fronds of *Laminaria*, for the distance of two or three feet, the creeping stems forming an intricate net-work from which the upright

stems arise in great abundance to the height of an inch or more. This species was particularly abundant on the reef off Watch Hill, and those obtained on the 13th of April were loaded with the reproductive capsules, (gonothecæ.)

At the same place we obtained luxuriant specimens of *O. flabellata*, (p. 390,) some of which were eight or ten inches long and profusely branched; these also bore reproductive capsules at the same date.

The curious *Antennularia antennina* was dredged off Gay Head in eight fathoms, where a number of large and fine specimens were obtained. This species had not been previously recorded from America, but it is not uncommon in the Bay of Fundy.

The Alcyonoid Polyps are represented by the northern *Alcyonium carneum*, (Plate XXXVIII, fig. 283,) which we dredged off Gay Head, off Cuttyhunk, and on the reef at Watch Hill. This species grows up into lobed or arborescently branched forms, with the delicate, translucent polyps mostly clustered toward the ends of the branches. The general color is translucent, pale yellow, or salmon, sometimes more or less tinged with orange or red. Among the Actinoids there is a species of *Edwardsia*, (*E. lineata* V.,) which is as yet undescribed. It occurred in considerable numbers crowded into the openings and interstices between ascidians, worm-tubes, &c. It is peculiar in having no distinct naked basal portion, at least in the numerous specimens hitherto seen, for in all cases the rough epidermis extended entirely over the base. The tentacles are long, slender, thirty or more, and each usually has a flake-white line down the center. The disk is usually marked with radiating white lines. This species was dredged off Gay Head and also on the reef off Watch Hill.

The Sponges are numerous on the outer rocky bottoms, and belong to about a dozen species, most of which are still undetermined; but they are nearly all northern forms, common in the Bay of Fundy.

One of the most common is the *Chalina oculata*, which forms thick, upright, more or less flattened stalks, which, as they grow larger, fork and divide into more or less numerous, and often digitate branches, which vary greatly in form and thickness; scattered over the surface are round orifices, about a tenth of an inch in diameter. The color is dull orange-red, when living, but the color disappears when the animal matter is removed, leaving the sponge white. The texture is open and quite delicate. Another very curious species, (*Polymastia?*) when young, forms yellowish white incrustations over stones and shells; later, it rises at several points into long, slender, round, tapering, finger-like prolongations, which do not branch, but are often so grouped as to give a digitate appearance to the whole. This was dredged off Gay Head in 18 to 20 fathoms, and is also common in the Bay of Fundy. One of the most abundant species of this region forms very irregularly shaped, uneven, pale yellow masses, attached to the stems and fronds of *Phyllophora* and other small algæ, and often, as it grows larger, spreading over and

entirely covering and destroying the algæ. The large openings (oscula) are irregularly scattered over the surface and quite unequal in size, varying from less than .05 to .10 of an inch or more in diameter. The texture is rather close when dried, showing a finely reticulated texture at the surface. This appears to belong to the genus *Tedania*. Another species, apparently of the same genus, occurs with the last, and has the same habits, but its color is pale buff, or yellowish white, and its texture is much firmer and more compact. Another species, occurring with the last two on the *Phyllophora*, at Watch Hill, forms small, irregular, deep yellow masses, of a soft and somewhat gelatinous consistency.

Foraminifera of several species are abundant, attached to the fronds of the red algæ, to the rough integument of Ascidians, to stones, shells, worm-tubes, &c., but they have not yet been identified.

List of species inhabiting the stony and rocky bottoms on the open coast.

ARTICULATA.

Crustacea.

Annelids.

Nemerteans and Planarians.

MOLLUSCA.

Gastropods.

Lamellibranchs.

Ascidians.

Bryozoa.

RADIATES.

Echinoderms.

Acalephs.

Polyps.

PROTOZOA.

Sponges.

IV. 4.—FAUNA OF THE SANDY AND GRAVELLY BOTTOMS OFF THE OPEN COAST.

The bottom off the southern shores of Nantucket and Martha's Vineyard is sandy or gravelly over large areas, from low-water mark down to 25 fathoms or more. Tracts of similar bottom occur off Cuttyhunk Island and farther west. In many of these places, especially in the shallower waters, near shore, the material of the bottom is nearly pure siliceous sand, varying in fineness from coarse gravel to the finest sand, and as these sands are generally loose and moved by the storm-waves, in shallow water, their inhabitants are but few. In deeper water, at depths of 20 to 25 fathoms or more, the material is usually a very fine sand, often firmly compacted, and not infrequently mixed with more or less fine mud. Such localities are favorable for a much greater variety

of animals, and especially for many burrowing annelids, crustacea, and bivalve shells. Bottoms of this character pass by insensible gradations into the true muddy bottoms, so that it is very difficult to make any sharp distinction between them, or between the animals that inhabit them. Several localities at which we dredged were quite intermediate in character, so that it is difficult to decide in which division they should be put. Yet there is a very wide difference between the animals of the pure sandy and of the soft muddy bottoms. Most of the localities where the bottom was of this mixed or intermediate character, and of very fine material, have been classed with the muddy bottoms, because the animals inhabiting them agree more closely with those of the true muddy bottoms than with those of the genuine sandy ones. But in each case I shall endeavor to give an idea of the fauna of typical localities of pure sand, of true mud, of muddy sand, and of sandy mud, so that the more general lists given under the sandy and muddy bottoms, respectively, need not cause confusion.

The special localities where dredgings were made on sandy bottoms are as follows: line 80, *a*, 16½ fathoms, siliceous sand; *b*, 18½ fathoms, siliceous sand; 81, *a*, *b*, 16½ fathoms, sand; 85, *a*, *b*, 15½ fathoms, siliceous sand and gravel; 86, *a*, *b*, 25 fathoms, sand and gravel, with some mud and small stones; off Watch Hill, 6 to 8 fathoms, loose siliceous sand, with some stones. Besides these a few other dredgings were made on similar bottoms, but not recorded.

Among the Crustacea that are characteristic of the true sandy bottoms are *Platyonichus ocellatus*, (p. 388, Plate I, fig. 4,) which is, however, more common in the sounds; *Eupagurus Bernhardus*, a decidedly northern hermit crab; *Crangon vulgaris*, (p. 339, Plate III, fig. 10;) *Ptilocheirus pinguis; Idotea Tuftsii.* Where the bottom is of loose siliceous sand, the common *Unciola irrorata* (p. 340, Plate IV, fig. 19) frequently occurs, usually associated with but few others, except a species of *Anonyx*, or some closely allied genus, which seems to live exclusively on such bottoms. This last species is rather stout, pale grayish or yellowish white, usually tinged with purple on the back The posterior portion is more decidedly purple, together with the caudal appendages and some of the last epimera. This was dredged off Watch Hill.

Several interesting species occurred on the bottoms of fine compact mud and sand, in 20–29 fathoms. Among these were *Phoxus Kroyeri*, which is a northern species; *Siphonœcetes cuspidatus* SMITH, an undescribed species; *Byblis serrata* SMITH, another very interesting new species; undetermined species of *Ampelisca*, &c.

Few Annelids are peculiar to true sandy bottoms. Among those of most interest are *Sthenelais picta* V., (p. 348;) *Lumbriconereis fragilis*, a northern and European species; *Anthostoma acutum* V.; and *Scolecolepis cirrata.* The last is a northern species found in the Bay of Fundy and north to the Arctic Ocean, and also on the northern coasts of Europe.

The color is chocolate-brown, with bright red, ligulate, dorsal branchiæ on the anterior third of the body. The two large tentacles exceed in length three times the breadth of the body; they are often coiled up, and are greenish in color. This worm is three or four inches long.

A large purple *Meckelia* (*M. lurida* V.) was dredged in two localities.

Among the Mollusks there are but few species that are characteristic of these bottoms, and probably none that are peculiar to them, unless some of the Ascidians should prove to be so. The *Molgula arenata* (p. 426, Plate XXXIII, fig. 251) is often common even on loose siliceous sand and gravel, with which it forms a coating over its body. The *Molgula producta* was dredged in some numbers on a bottom of fine sand, with some mud. The integument is thin, translucent, closely covered with a layer of fine sand; the tubes are transparent, whitish or flesh-color, sometimes pink at the ends; anal tube with four, and branchial with six, flake-white, longitudinal stripes, and often with a circle of flake-white spots at the base outside, and other spots within. The anal orifice is square, but the branchial is either subcircular or squarish, in expansion, and destitute of distinct lobes or papillæ, in this respect differing from all the other species of the genus. The branchial tube is generally a little the longest, and both of them are somewhat tapered, with a swollen base.

The *Glandula arenicola* is another nearly globular Ascidian, which lives, like the two preceding, free in the sand, and covers itself with a closely-adherent coating of sand. This species grows to be about half an inch in diameter, and can easily be distinguished from the last by its much smaller tubes, both of which have small square orifices, and by its thicker and firmer integument, in which the sand appears to be somewhat imbedded. At the base there are some slender fibers for anchoring it more securely in the sand. This was dredged by Mr. Prudden, off Cuttyhunk Island, in 1872. Messrs. Smith and Harger dredged it in great abundance last year on St. George's Bank, on a bottom of clear siliceous sand, in 28 fathoms. Dr. Dawson has also dredged it in Murray Bay, in the St. Lawrence River. It is, therefore, a decidedly northern species.

Another species of *Glandula* also occurred on the true sandy bottoms. The specimens of this were all small, mostly less than a fifth of an inch in diameter, and the integument was densely covered by rather coarse and very firmly adherent grains of sand, in several layers; the sand completely concealed the tubes from view in all the specimens observed, and it was not sufficiently studied while living to afford an accurate description.

The Bryozoa and Hydroids that are found on the sandy bottoms are mostly attached to dead shells and small stones that are scattered over the surface.

Of Echinoderms several species occur on the hard bottoms of fine, compact sand, or sandy mud, but most of these are more at home on rocky bottoms.

On the bottoms of loose siliceous sand the *Echinarachnius parma* (p. 362, Plate XXXV, fig. 267) is often very abundant. Several hundred are sometimes obtained at a single cast of the dredge. At locality 81, *b*, off the south coast of Martha's Vineyard, in 21 fathoms, on a bottom of clear siliceous sand, Dr. A. S. Packard dredged a fine specimen of a rare and little known Holothurian, the *Stereoderma unisemita*. This has not been found before, so far as known to me, since the two original specimens were described twenty years ago. One of those was from the Banks of Newfoundland, and the other was supposed to have been from off Massachusetts Bay. As both the original specimens appear to have been lost or destroyed, this rediscovery was of considerable interest. This specimen was about three inches long, and half an inch in diameter, fusiform, tapering to each end; the body and suckers were pale flesh-color, and the integument is filled with a great abundance of small calcareous plates.

Most of the Polyps and Sponges that occur on these sandy bottoms are attached to the scattering dead shells and small stones or pebbles, and belong properly on the rocky and stony bottoms. One large and fine sponge seems, however, to be peculiar to the sandy bottoms. This is a firm, siliceous sponge, with a very compact and fine texture. It is quite irregular in shape, but often grows in the form of elongated, compressed masses, attached by one edge; these masses are often six inches or more in length and one or two in thickness, and perhaps two or three high. Some of the largest specimens consist of two or three such crest-like plates or lobes attached together at base. When living the color is bright sulphur-yellow or lemon-yellow, and the surface is nearly smooth. One fine living specimen, of large size, was dredged by Dr. Packard off the southern shore of Martha's Vineyard, at locality 80, *b*, on a bottom of clear siliceous sand. Numerous specimens were also found thrown on Edgartown beach. These were mostly bleached out white and more or less worn. This species has not yet been identified. I have specimens of it from the coast of Virginia.

A very curious organism, of which the nature is still uncertain, but which was supposed, at the time it was taken, to belong to the sandy Foraminifera, was often extremely abundant in the clear siliceous sand. They were nearly circular, somewhat flattened or biscuit-shaped, and entirely covered by adherent grains of sand, except that there were several dark-colored, hook-like processes projecting from the circumference. The size was generally less than a fifth of an inch in diameter, and more frequently not more than .12 to .15 of an inch. When dried they became very friable, and the sand fell asunder at a slight touch, so that they then appeared like mere lumps of sand, but they retain their firmness when preserved in alcohol. They were often so abundant in the fine sand that when a dredge-full was washed through a moderately fine sieve several hundreds or thousands would sometimes remain in the sieve.

List of species inhabiting sandy and gravelly bottoms.

In the following list I have included nearly all the species that ordinarily occurred on those bottoms in which sand predominated, even though some of them are more strictly muddy-bottom species. Others belong more properly on rocky, stony, or shelly bottoms, but are introduced here because they occur attached to the scattered shells and stones that are always liable to be met with on sandy bottoms.

In order to designate those species that are more strictly characteristic of the clear sandy bottoms, I have prefixed to them a dagger, (thus: †.) To show the character of the fauna on the bottoms of mixed or intermediate character, I have selected a single locality, 86, *b*, southwest of Cuttyhunk Island and opposite the mouth of Buzzard's Bay, where the depth was twenty-five fathoms, and the bottom consisted of fine sand mixed with some mud and gravel, with a few small scattered stones, and have prefixed an asterisk (thus: *) to such species as occurred at that particular locality, though most of them occurred also at other localities.

ARTICULATES.

Crustacea.

Annelids.

Nemerteans and Planarians.

Sipunculoids.

MOLLUSCA.

Gastropods.

Lamellibranchs.

Ascidians.

Bryozoa.

RADIATA.

Echinoderms.

Acalephs.

Polyps.

PROTOZOA.

Sponges.

IV. 5.—Fauna of the muddy bottoms off the open coast.

Within the depths to which our dredgings extended, very few true muddy bottoms occur. The deposits of mud on the open coast usually begin to occur only at the depths of twenty-five to thirty fathoms, and even at these depths there is a considerable admixture with fine siliceous sand. The central and deeper portion of the depression in line with the axis of Vineyard Sound is, however, occupied off to the west of Gay Head and No Man's Land by a deposit of fine, soft, sticky mud, filled with the tubes of Annelids and Amphipods, (*Ampelisca*, &c.) Dredgings were made on this bottom at localities 85, *c*, in 18 fathoms; *d*, 19 fathoms; *e*, 11 fathoms. On September 9, the temperature at 85, *c*, was 58° Fahrenheit at the bottom, and 62° at the surface; at *d*, it was 57° at the bottom and 62° at the surface; at *e*, it was 59° at the bottom and 63° at the surface. This muddy bottom abounded in Annelids, small Crustacea, and bivalve shells.

In several other localities, where the bottom was a mixture of mud and fine sand, the mud seemed to predominate and to determine the character of the life, so that such localities have been classed with the muddy bottoms, though the fauna differed considerably from that of the soft muddy bottoms referred to above. In the following list, however, I have specially designated the species found in the typical localities of each kind.

The principal localities where we dredged on the bottoms of fine sandy mud are as follows: 80, *c*, south of Martha's Vineyard, in 21 fathoms; 84, *b*, southwest of Gay Head, in 16 fathoms; 87, *a*, *b*, about fifteen miles east of Block Island, in 29 fathoms. At the last locality the temperature, on September 14, was 62° F. at the surface, and 59° at the bottom.

Among the Crustacea none was more abundant on the soft, muddy bottoms than a small species of *Ampelisca*, which inhabits soft, flabby tubes, covered with fine mud. When taken out of the water these tubes are always collapsed and flat, and they were so abundant in the mud that it was almost impossible to wash it through the sieves, because they soon became completely clogged up with the tubes. When a quantity of the mud was left in a bucket of water these Crustacea would come out of the tubes and rise to the surface in large numbers. This species is generally quite pale, or nearly white. Its body is much compressed.

Another variety, or perhaps a distinct species, found with the last, is pale flesh-color, with a row of bright red spots along the middle of the back; the antennæ were specked with red; eyes bright red; epimera reticulated with red lines; and the legs and caudal appendages are more or less marked with red.

The *Unciola irrorata*, (p. 340,) *Ptilocheirus pinguis*, and other Amphipods, were associated with the preceding species.

The *Diastylis quadrispinosa* (Plate III, fig. 13) was very abundant on the soft muddy bottoms, together with other species of Cumacea, not yet identified. It is pale flesh-color, with a reddish purple patch at the posterior part of the carapax, and two small spots of pink.

The Annelids were very numerous, both on the soft muddy bottoms and in the sandy mud. One of the most conspicuous species is the *Aphrodita aculeata*, which was common in the soft mud. This is a large, stout Annelid, the largest specimen obtained measuring about 3 inches in length, and about half as much in breadth. It is remarkable for the exceedingly numerous and long setæ of many kinds, which cover its sides and back, except along a narrow dorsal space; some of these setæ are stout, and nearly an inch long, with sharp points, and barbed near the end, and they curve over the back much like the quills of a porcupine, and are liable to inflict painful wounds, if the creatures are carelessly handled. These setæ usually reflect bright, iridescent colors.

Several other northern European species, found also in the Bay of Fundy and at Saint George's Banks, were also met with. Among these were *Lumbriconereis fragilis*, *Scolecolepis cirrata*, *Melinna cristata*, *Terebellides Stroëmi*, and several more common species.

The *Nephthys ingens* (p. 431, Plate XII, figs. 59–60) is a very abundant species on these bottoms and grows to a large size.

The curious *Sternaspis fossor* (Plate XIV, fig. 74) is quite common; and the *Trophonia affinis* (Plate XIV, fig. 75) was dredged several times.

Many other species were also common, or even abundant, in the various localities, and quite a number proved to be undescribed, and therefore their descriptions will be found in the systematic catalogue accompanying this report. Among these were *Lycidice Americana*, *Ninoë nigripes*, *Anthostoma*, sp., *Acutum*, *Ammotrypane fimbriata*, *Travisia carnea*, Eone gracilis, *Brada setosa*, *Nicomache dispar*, *Rhodine attenuata*, a species of *Ammochares*, *Ampharete gracilis*, *Euchone elegans*, and a species of *Nematonereis*.

Several species of *Nemerteans* also occur on these bottoms. The largest and most interesting is a large species of *Meckelia*, (*M. lurida*, V.) This grows to the length of 8 or 10 inches, and .25 broad; its color is deep chocolate-brown, with paler margins. It generally breaks up into numerous fragments when caught. Another species, belonging, perhaps, to the genus *Cerebratulus*, but not sufficiently studied while living, was 2 or 3 inches long in extension, and .05 to .08 of an inch broad. Its color was dark olive-green, darkest anteriorly, the head with a white margin. The lateral fossæ of the head were long and deep; the eyes inconspicuous, perhaps wanting; proboscis emitted from a terminal pore; the ventral orifice, or mouth, placed well forward. Both this and the preceding were found at the 29-fathom locality, in sandy mud, but the former also occurred in soft mud, in 19 fathoms.

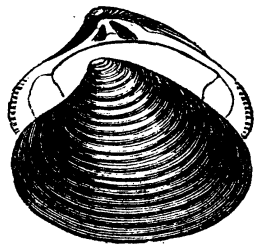
One of the most abundant Gastropods is *Neptunea pygmæa*, (Plate XXI, fig. 115,) which is a rather northern shell, very common in the Bay of Fundy. The specimens from this region are, however, quite as large as any that I have seen from farther north. The small disk-shaped egg-capsules of this shell were found in great abundance early in September attached to various bivalve shells, as well as to the shells of the *Neptunea* itself.

Buccinum undatum, (Plate XXI, Fig. 121;) *Bela harpularia*, (Plate XXI, fig. 108;) *Lunatia immaculata*, (Plate XXIII, fig. 131;) *Margarita obscura*, (Plate XXIV, fig. 156;) *Astyris rosacea;* and *Cylichna alba*, (Plate XXV, fig. 163,) are all northern shells, which were met with in small numbers on the muddy bottoms.

The Lamellibranchs were quite abundant. One of the most conspicuous is the northern *Cyprina Islandica*, (Plate XXVIII, fig. 201,) which was quite common at several localities, especially in soft mud.

Many of the shells from the deeper dredgings in this region are northern and even arctic species, several of which have been supposed not to occur south of Cape Cod. Among these northern forms are *Macoma proxima*, of which we dredged a few small specimens; *Cyclocardia borealis* and *C. Novangliæ* (p. 418,) both of which were common; *Astarte undata*, (Plate XXIX, fig. 203,) which was dredged in considerable abundance at several localities. A large proportion of the shells of this species, obtained here, were quite different in appearance from the varieties that occur in such abundance in the Bay of Fundy. The latter,

Fig. 3.



although quite variable in form and sculpture, are generally compressed; those from this region are mostly rather swollen, and often decidedly obese. These correspond with the type-specimen of *A. lutea* PERKINS, from New Haven, (fig. 3,) which I have been able, through the kindness of Dr. Perkins, to compare directly with our specimens. This form is, perhaps, sufficiently well marked to be designated a sa variety, *(lutea,)* but many specimens intermediate between this and the ordinary forms occurred. This variety resembles the European *A. sulcata* more closely than do any of the other varieties of our species, but in the character of the hinge, lunule, beaks, and sculpture, it differs decidedly from any European specimens that I have seen. The *Astarte quadrans* (Plate XXIX, fig. 205) was rarely met with. Good-sized specimens of the large scollop, *Pecten tenuicostatus*, were dredged off Gay Head on hard bottoms, and also on the muddy bottom, in 29 fathoms, and in several other localities. The northern *Anomia aculeata* (Plate XXXII, figs. 239, 240) occurred adhering to dead shells. The *Modiolaria corrugata* (Plate XXXI, fig. 235) was dredged several times in the deepest localities, but *M. lævigata*, recorded by Mr. Sanderson Smith, was not met with by us; nor *Leda tenuisulcata*, which has been found off Newport, Rhode Island. The *Nucula delphinodonta* (Plate XXX, fig. 229) was common on soft muddy bottoms. The *Lucina filosa* (Plate XXIX, fig. 212) appeared to be not uncommon on similar bottoms, but most of the specimens obtained were less than an inch in diameter. Small specimens of *Periploma papyracea* (Plate XXVII, fig. 197) were frequently dredged. The specimens of *Thracia truncata* (Plate XXVII, fig. 195) were few and small. The *Cryptodon obesus* V., (Plate XXIX, fig. 214,) was first discovered in this region, but all the specimens were of large size and dead, though mostly quite fresh. I have since seen smaller specimens from Labrador, &c. *C. Gouldii* (Plate xxix, fig. 213,) is more common. *Yoldia sapotilla* (Plate XXX, fig. 231) was generally abundant, especially in the soft mud, but *Y. obesa* was only met with once, and in small numbers, in 29 fathoms; *Y. thraci-formis* we did not meet with, but Dr. Simpson records it from off Long Island.

Of Ascidians very few species occur. The most abundant is *Eugyra pilularis*, (Plate XXXIII, fig. 249,) which, in contraction, looks like a round ball of mud, for it completely covers itself with a thick coating of fine sand or mud, which is held in place partly by delicate fibrous processes from the integument, those from the base being longer, and serving to anchor the little creature in the sand by attaching a considerable quantity of sand to themselves. When the sand is removed, the integument is found to be thin and quite translucent, the tubes, when extended, are long and transparent, close together, and inclosed by a naked band which surrounds the base of both. It is also very

Figure 3. Original figure of *Astarte lutea*, natural size. From the Proceedings of the Boston Society of Natural History.

common in the Bay of Fundy, &c. The *Molgula producta* (p. 502) also occurred on the sandy mud at the 29-fathom locality.

The Echinoderms appear to be very scarce on these bottoms. The only one of special interest was the *Molpadia oölitica*, a small, round, rather slender species, about an inch and a half long, of a uniform flesh-color. Of this only one specimen was dredged, at the 29-fathom locality, fifteen miles east of No Man's Land, by Dr. Packard. It had not been observed alive before, the only specimens previously known having been taken from the stomachs of fishes.

The most interesting Hydroid that lives on the muddy bottoms is *Corymorpha pendula*, (Plate XXXVI, fig. 273.) This is a very beautiful species, which grows singly, with the bulb-like base of the stem inserted into the mud.

Two interesting species of Polyps were found on the muddy bottoms. One of these, the *Edwardsia farinacea*, occurred only on the soft muddy bottom off Gay Head, in 19 fathoms. It is a cylindrical species, about an inch long, and .10 or .12 of an inch in diameter, remarkable for having only 12 tentacles, which are equal, unusually short, thick, and blunt. The coating of mud in the middle region is thin and easily removed.

The single specimen obtained here had only 10 tentacles, but in other respects it agrees essentially with those found on similar bottoms at several localities in the Bay of Fundy, all of which had 12 tentacles. The body is whitish or flesh-color, the naked portion below the tentacles; in the specimen from off Gay Head, was striped with 10 longitudinal lines or bands of brown, corresponding with the tentacles; these bands were varied with flake-white specks and mottlings, the spots of white becoming more distinct near the tentacles; these bands were alternately lighter and darker. Tentacles translucent at tip, tranversely barred on the inside, with about five brown bands and spots, the lower ones often V-shaped or W-shaped, and some of them extend around to the outside of the tentacles; alternating with these brown bands were bars and spots of yellow and of white. The disk was pale yellow, varied with small brown spots, mostly forming radiating rows from the mouth to the bases of the tentacles, and there were two spots of brown between the bases of adjacent tentacles; mouth with ten lobes, which were also brown, with a fine light line extending from between them to the intervals between the tentacles. The specimens from the Bay of Fundy vary considerably in color, but the above is one of the more frequent styles of coloration.

The *Epizoanthus Americanus* (Plate XXXVIII, figs. 286, 287) is a very singular species, which either lives attached to stones, as in the deeper parts of the Bay of Fundy and off Saint George's Bank, in 430 fathoms, or else it attaches itself to univalve shells, inhabited by hermit-crabs. All those obtained in this region had the latter habit, and were from the 29-fathom place, fifteen miles east of Block Island, on sandy mud. After one original young polyp has found lodgment and attached itself to the shell, its base begins to expand over the surface of the shell, and from

this basal membrane buds arise, which soon grow larger and become like the parent polyp, while the basal membrane continues to extend itself and new buds to develop, until the whole shell becomes incrusted by the membrane, inside and out, while a number of beautiful polyps arise from the upper side of the shell, and turn their mouths in different directions. The number of the polyps in these colonies varies, according to the size of the shell, from three to ten or more. Finally, by some chemical process, the polyps, or rather their basal membranes, dissolve the shell entirely, and apparently absorb it into themselves. And yet the membranes retain the spiral form of the shell very perfectly, and the hermit crab eventually actually lives inside the membranes of the polyps, which continue to grow and even to enlarge the chamber for the use of the crab, so that it need not change its habitation for a larger one as it grows older. When fully expanded these polyps are about an inch high, and are capable of changing their form considerably, but they are generally more or less cylindrical, or else hour-glass shaped. There are 38 or more tentacles, in full grown ones, and they are subequal, long, slender, acute, arranged in two close circles, and usually held in a recurved position, (as in fig. 287,) with those of the outer circle more recurved than those of the inner ones; corresponding with the bases of the alternate tentacles there is an outer circle of triangular points or lobes, covered externally, like the rest of the exterior of the body, with adherent and imbedded grains of fine sand. The mouth is bilabiate, often somewhat raised on a conical protrusion of the disk, the lips many-lobed, or plicate. The integument of the body when fully expanded is translucent, pale flesh-color, or salmon-color; disk and tentacles salmon-color, or pale orange, sometimes white, the lips and inside of the mouth brighter orange.

List of species inhabiting bottoms composed of soft mud and sandy mud off the outer coast.

In the following list those species that were found on the soft, sticky mud, in 11 to 19 fathoms, off Gay Head, are designated by the sign ‡, prefixed to their names. Those that occurred at 87, *a*, *b*, in 29 fathoms, fine sandy mud, fifteen miles east of Block Island, are designated by an asterisk prefixed.

ARTICULATA.

Crustacea.

Annelids.

Nemerteans and Planarians.

Sipunculoids.

MOLLUSCA.

Gastropods.

Lamellibranchs.

B.—LISTS OF SPECIES FOUND IN THE STOMACHS OF FISHES—FOOD OF FISHES.

In the following lists I have brought together the principal results of the various recorded examinations of stomachs of fishes in this region, up to the present time, whether done in connection with the United States Fish Commission or independently. The special dates and localities are given in each case.

The observations from June to September, 1871, were made in connection with the work of the commission. Those from May to July, 1872, are based on collections made at Wood's Hole by Mr. Vinal N. Edwards, for Professor Baird. Those at Great Egg Harbor, New Jersey, April, 1871, were made by Mr. S. I. Smith and the writer while on an independent visit to that place.* The observations made at Eastport, Maine, in 1872, are not included in this report.

The names of the fishes used in this list are those adopted by Professor Baird, and agree, for the most part, with those used by Professor Theodore Gill in his Catalogue of the Fishes of the Eastern Coast of North America.

STRIPED BASS; ROCK-FISH, OR "ROCK;" (*Roccus lineatus.*)

At Great Egg Harbor, New Jersey, April, 1871, several specimens, freshly caught in seines, with menhaden, &c., contained *Crangon vulgaris* (shrimp) in large quantities.

A specimen caught at Wood's Hole, July 22, 1872, contained a large mass of "sea-cabbage," *Ulva latissima*, and the remains of a small fish.

Specimens taken at Wood's Hole, August, 1871, contained crabs, *Cancer irroratus;* and lobsters, *Homarus Americanus.*

WHITE PERCH; (*Morone Americana.*)

Numerous specimens caught with the preceding at Great Egg Harbor, New Jersey, contained *Crangon vulgaris.*

BLACK BASS; SEA-BASS; (*Centropristis fuscus.*)

Specimens caught in Vineyard Sound, June 10, contained the common crab, *Cancer irroratus;* the mud-crab, *Panopeus Sayi;* three species of fishes.

Another caught May 25 contained a squid, *Loligo pallida.*

SCUP; PORGEE; (*Stenotomus argyrops.*)

Forty young specimens, one year old, taken at Wood's Hole in August, contained large numbers of Amphipod Crustacea, among which were *Unciola irrorata*, *Ampelisca*, sp., &c.; several small mud-crabs, *Panopeus depressus; Idotea irrorata; Nereis virens*, and numerous other Annelids of several species, too much digested for identification.

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* The results of the observations made at Great Egg Harbor were published by the writer in the American Naturalist, vol. v, p. 397, 1871.